The Egg Masses and Veligers of Southern California Sacoglossan Opisthobranchs

BY

RICHARD W. GREENE

Department of Zoology, University of California, Los Angeles, California 90024

(6 Text figures)

INTRODUCTION

HURST (1967) HAS DEMONSTRATED the importance of egg masses and veliger larvae to the systematics of northeast Pacific opisthobranchs. The present paper deals with the order Sacoglossa as an addition to the work of HURST, and as a contribution to our knowledge of this group. HURST (*op. cit.*) has described the egg mass and veliger of *Olea hansineensis* AGERSBORG, 1923 (Sacoglossa: Oleidae). A brief description of the egg mass of *Hermaeina smithi* MARCUS, 1961 has been given by GONOR (1961), and LANCE (1962) has given a short description of egg masses of *Stiliger fuscovittata* LANCE, 1962 (both Sacoglossa: Hermaeidae).

The animals included in the present study are *Elysia hedgpethi* MARCUS, 1961 (Elysiidae), *Hermaea dendritica* ALDER & HANCOCK, 1846 and *Hermaeina smithi* (Hermaeidae). All three species were collected intertidally in Los Angeles County, California. In order to make the data more useful, the methods used by HURST (1967) for description of egg masses and veligers have been applied.

EGG MASSES

All the egg masses described in this paper belong to the Type B of HURST (1967). They are more or less cylindrical in cross-section through the individual egg bands. When attached to a flat substrate, the masses possess a very thin jelly-free layer, while those found tangled among filamentous algae (i. e., *Chaetomorpha*) have no apparent jelly-free layer.

Elysia hedgpethi (Text figure 1; Tables 1 and 2):

The egg mass of *Elysia hedgpethi* (Figure 1) is in the form of a counter-clockwise spiral. The mass is invariably attached along its entire length to the substrate. In the field the eggs are laid among the fronds of *Codium fragile* HARIOT, 1889, the alga upon which the animal lives and feeds. Individual masses of eggs may range between 4 and 6 mm in diameter. The egg band itself measures between 1 and 2 mm in width depending upon the size of the spawning animal. The terminal portion of the egg band sometimes encloses several capsules containing no ova. A single ovum is found in each capsule. The entire egg mass is white in color, and the eggs within the band appear randomly distributed in space.

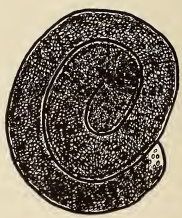


Figure 1
Egg mass of *Elysia hedgpethi*

The pattern of spawning and structure of the egg mass of *Elysia hedgpethi* closely resembles that of *E. maoria* POWELL, 1937 from New Zealand (REID, 1964).

Hermaea dendritica (Text figure 2; Tables 1 and 2):

This species lays an egg mass very similar to that of *Elysia hedgpethi*. The mass is in the form of a counter-clockwise spiral and is found in the field attached to the fronds of *Codium fragile*. When kept in captivity, *Hermaea* may lay thread-like masses along the glass sides of the container. The egg mass of *H. dendritica* is white and is attached to the substrate along its entire length (Figure 2). The eggs are deposited in a spiral within the egg mass which serves to distinguish the egg mass of *H. dendritica* from that of *E. hedgpethi*, which is found on the same alga species.

Table 1

Characteristics of the Egg Masses of Sacoglossans

	Color		Width of egg string		Attachment			2nd twisting		Eggs/capsule	Veliger type		Days taken	
	White	Yellow	<1 mm	>1 mm	Most of length	Other	Present	Absent			Uninflated	Inflated	To hatch	Appearance of Veliger
Elysia hedgpethi	×			×	×			×		1	×		14	10
Hermaea dentritica	×			×	×			×		1	×		7-8	5
Hermaeina smithi	×	×		×	×	×[1]		×		1	×		5-6	4

[1] see description

Hermaeina smithi (Text figures 3a, 3b; Tables 1 and 2):

The egg masses of *Hermaeina smithi* take at least two different forms (Figures 3a and 3b). Gonor (1961) has described masses taking the shape of a "C" with a total length of about 20 mm. These are the most common type found in aquaria when animals are kept in captivity. In the field, however, the masses are deposited as tangled strings among the filaments of *Chactomorpha aerea* Kützing, 1849. Tangled strings are also frequently found on the sides of glass aquaria containing *H. smithi*. These masses are a variation on the plano-spiral mass (Figures 1 and 2) and differ in that they are attached to the substrate only at intermittent points along their length (Figure 3b). The C-shaped masses are found either floating on the surface film of the aquarium or are attached along their entire length to the glass surface. The egg capsules appear to be arranged in a spiral pattern inside the egg mass.

Figure 2
Egg mass of *Hermaea dendritica*

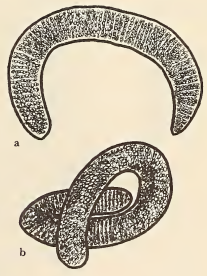
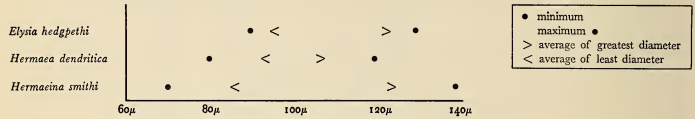


Figure 3
Egg masses of *Hermaeina smithi*

In addition to the two shapes of egg masses observed, there are also two color types. Gonor (1961), working with specimens from San Juan Island, Washington, has described the eggs as being "lemon-yellow" when spawned, becoming paler with further development. In the present study of *Hermaeina smithi* collected in southern California, both yellow and white egg masses were deposited by

Table 2

Egg Capsule Dimensions



adults and were observed through hatching. The yellow masses became visibly paler with development, while the white egg masses remained white.

VELIGER SHELLS

The veliger shells of the three species of sacoglossans studied are of the uninflated type, or Type I. Hurst

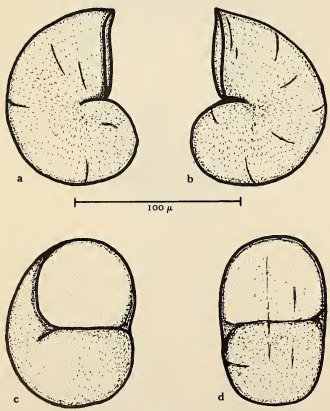


Figure 4

Veliger Shell of *Elysia hedgpethi*

a – right side b – left side c – ventral d – dorsal

(1967) discussed at length the difficulties of orienting veliger shells for measurement. Table 1 gives data on development of the egg masses, and Table 3 gives measurement data and length : width : depth ratios for the veliger shells.

Elysia hedgpethi (Text figure 4; Tables 1 and 3):

The veliger shell of *Elysia hedgpethi* resembles that of both other species in the present study in that the only apparent sculpture consists of minute pits over the entire surface of the shell which are visible only under 150× magnification. The lip around the aperture is somewhat variable in that the anterior portion may project beyond the rest of the lip (Figure 4a) or may be even with it. In general, the gross shape of the shell seems to be of major importance when comparing it with other species (i. e., Figures 5 and 6).

Hermaea dendritica (Text figure 5; Tables 1 and 3):

Of the species considered in the present study, *Hermaea dendritica* has the roundest of the shells examined. In addition, Figure 5 shows that the posterior portion of the shell is narrower than the anterior portion, and that there is little evidence of coiling externally (Figure 5a). Sculpture consists of small pits as in the other two species.

Hermacina smithi (Text figure 6; Tables 1 and 3):

The apertural lip on the veliger is commonly flared, though not all shells examined had this appearance (Figure 6). Sculpturing is manifested once again by small pits over the surface of the veliger shell. Of the three species included in the present study, *Hermacina smithi* shows the greatest degree of coiling on the right side.

DISCUSSION

The usefulness of data on opisthobranch egg masses and veliger larvae has been pointed out by Hurst (1967) along with the problems of obtaining such data. Thompson (1961) discussed the importance of veliger shells in the classification of sacoglossans.

Table 3

Veliger Shell Dimensions

	Observations	Length	Width	Depth	Ratio L:W:D
Elysia hedgpethi	10	105μ ±20.6	66.1μ ±11.2	77.8μ ± 3.1	1.59 : 1 : 1.17
Hermaea dendritica	10	97μ ±15.0	65.5μ ± 8.2	71.2μ ±11.2	1.48 : 1 : 1.09
Hermacina smithi	10	109μ ± 1.7	69.5μ ± 3.6	79.5μ ± 6.1	1.57 : 1 : 1.14

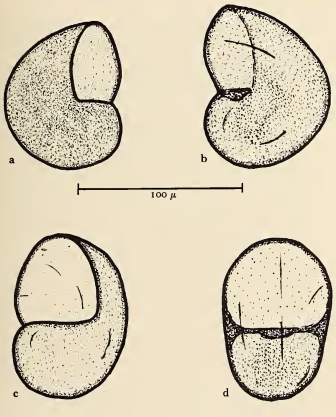


Figure 5

Veliger Shell of *Hermaea dendritica*

a – right side b – left side c – ventral d – dorsal

The egg masses of sacoglossans may be distinguished not only by their gross form and positioning of egg capsules, but also to a great extent by where they are found in the field. Sacoglossan opisthobranchs are found in specific habitats such as fronds of algae and generally leave their eggs on the algal substrate. Thus, eggs of *Elysia hedgpethi* and *Hermaea dendritica* are found on the fronds of *Codium fragile*, while egg masses of *Hermacina smithi* are found among the filaments of *Chaetomorpha aerea*, or, as reported by Gonor (1961), among the various algae in the *Enteromorpha* mat. Lance (1962) shows an egg mass of *Stiliger fuscovittata* attached to *Polysiphonia pacifica* Hollenberg, 1942, the alga upon which the animal feeds.

It is interesting to note that the three species of sacoglossans considered all maintain a symbiotic relationship

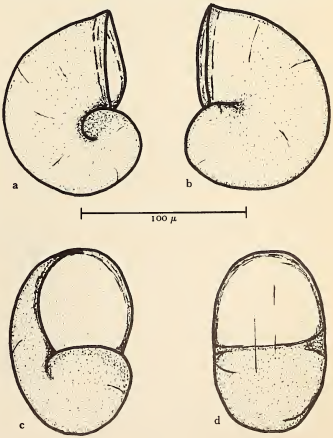


Figure 6

Veliger Shell of *Hermacina smithi*

a – right side b – left side c – ventral d – dorsal

with the chloroplasts of their algal substrate (Greene, in preparation). The chloroplasts are obtained during feeding and are retained within the cells of the digestive diverticula in a functional condition. The egg masses have been examined for evidence of transmission of chloroplasts from one generation to the next, and the results are negative. The chloroplast symbionts are apparently not obtained until some time after settling and metamorphosis of the veligers.

The veliger shells of the species described here are distinguishable by their gross form and dimensions. The shells of all three species are small compared with most of those described by Hurst (1967). The egg masses and veliger shells described here correspond well with those described for sacoglossans in other parts of the Pacific Ocean (Ostergaard, 1950; Reid, 1964).

ACKNOWLEDGMENT

The author wishes to express gratitude to Dr. Leonard Muscatine of the Department of Zoology, University of California at Los Angeles for his critical reading of the manuscript and to James R. Lance for confirmation of identifications of species used in the study.

LITERATURE CITED

Gonor, Jefferson J.
1961. Observations on the biology of *Hermaeina smithi*, a sacoglossan opisthobranch from the west coast of North America. The Veliger 4 (2) : 85 - 98; 13 text figs. (1 Oct. '61)

Hurst, Anne
1967. The egg masses and veligers of thirty Northeast Pacific opisthobranchs. The Veliger 9 (3) : 255 - 288; plts. 26 - 38; 31 text figs. (1 January 1967)

Lance, James Robert
1962. A new *Stiliger* and a new *Corambella* (Mollusca: Opisthobranchia) from the Northwestern Pacific. The Veliger 5 (1) : 33 - 38; plt. 6; 10 text figs.

Ostergaard, Jens Mathias
1950. Spawning and development of some Hawaiian marine gastropods. Pac. Sci. 4 (2) : 75 - 115.

Reid, J. D.
1964. The reproduction of the sacoglossan opisthobranch *Elysia maoria*. Proc. Zool. Soc. London 143 (3) : 365 - 393

Thompson, Thomas E.
1961. The importance of the larval shell in the classification of the Sacoglossa and the Acoela (Gastropoda, Opisthobranchia). Proc. Malacol. Soc. London 34 (5) : 233 - 239